WHAT IS CLAIMED IS:

1. A method for manufacturing halogen gas, comprising the steps of: introducing gas expressed in the chemical formula A_iX_j (A represents metallic element or semiconductor element; X represents halogen element; and i and j represent integers) into a reaction container in vacuum; generating plasmas in the reaction container so as to produce a plasma chemical reaction; removing fine particles produced by the plasma chemical reaction and containing an element other than halogen element as the major constituent from the reaction container so as to generate halogen gas in the reaction container.

2. A method for manufacturing halogen gas, comprising the steps of: introducing gas expressed in the chemical formula A_iX_j (A represents metallic element or semiconductor element; X represents halogen element; and i and j represent integers) into a reaction container in vacuum; generating plasmas in the reaction container so as to produce a plasma chemical reaction; collecting fine particles produced by the plasma chemical reaction and containing an element other than halogen element as the major constituent to a fine particle collecting part installed in the reaction container or in a fine particle collection container connecting with the reaction container so as to proceed the plasma chemical reaction, thereby generating halogen gas in the reaction container.

3. A method for manufacturing halogen gas, comprising the steps of: introducing gas expressed in the chemical formula $A_kX_lO_m$ (A represents metallic element or semiconductor element; X represents halogen element; O represents oxygen; and k, l, and m represent integers) into a reaction container in vacuum; generating plasmas in the reaction container so as to produce a plasma chemical reaction; collecting fine particles produced by the plasma chemical reaction and containing an element other than halogen element as the major constituent to a fine particle collecting part installed in the reaction container or in a fine particle collection container connecting with the reaction container so as to proceed the plasma chemical reaction, thereby generating halogen gas in the reaction container.

4. A method for manufacturing halogen gas, comprising the steps of: introducing gas expressed in the chemical formula $A_rX_sN_t$ (A represents metallic element or semiconductor element; X represents halogen element; N represents nitrogen; and r, s, and t represent integers) into a reaction container in vacuum; generating plasmas in the reaction container so as to produce a plasma chemical reaction; collecting fine particles produced by the plasma chemical reaction and containing an element other than halogen element as the major constituent to a fine particle collecting part installed in the reaction container or in a fine particle collection container connecting with the reaction container so as to proceed the plasma chemical reaction, thereby

generating halogen gas in the reaction container.

5. A method for manufacturing halogen gas according to claim 2, wherein the fine particle collecting part includes an electrode plate applied with a positive potential against the ground.

6. A method for manufacturing halogen gas according to claim 1, wherein A represents silicon (Si), X represents fluorine (F), and $i < j$.

7. A method for manufacturing halogen gas according to claim 1, wherein the gas introduced into a reaction container in vacuum further contains oxygen gas or nitrogen gas.

8. An apparatus for manufacturing halogen gas comprising: a reaction container; a gas introduction part which introduces gas into the reaction container; a plasma exciting electric field application part which generates plasmas in the reaction container; and a fine particle collecting part which is installed in the reaction container or in a fine particle collection container connecting with the reaction container.

9. An apparatus for manufacturing halogen gas according to claim 8, wherein the fine particle collecting part includes an electrode plate applied with a positive potential against the ground.

10. A halogen gas recovery and circulatory system comprising: a vacuum chamber accommodates a substrate to be processed; a gas separation and refinement mechanism connected

to the vacuum chamber and recovers exhaust gas produced during the process in the vacuum chamber, and separates the gas containing halogen element and metallic element or semiconductor element from the exhaust gas so as to refine it; a pipe connected with the gas introduction part of the apparatus for manufacturing halogen gas according to claim 8 and conveys the separated and refined gas containing halogen element and metallic element or semiconductor element from the gas separation and refinement mechanism to the said gas introduction part; and the halogen gas drawing part connected in one part with the apparatus for manufacturing halogen gas and connected in the other part with the halogen gas introduction part of the vacuum chamber.